DOCUMENT RESUME

ED 382 085 HE 028 272

AUTHOR	El-Khawas, Elaine; Anderson, Charles J.
TITLE	Developing Our Future: American R&D in International Perspective.
INSTITUTION	American Council on Education, Washington, D.C. Div. of Policy Analysis and Research.
PUB DATE	93
NOTE	14p.
AVAILABLE FROM	American Council on Education, One Dupont Circle, Suite 800, Washington, DC 20036 (single copy $10; 8-issue annual subscription $58).
PUB TYPE	Collected Works - Serials (022)
JOURNAL CIT	Research Briefs; v4 n7 1993
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Cross Cultural Studies; Economic Development; Engineers; Federal Programs; Foreign Countries; Government Role; Higher Education; *Institutional Role; *Research; *Research and Development; Research Utilization; Scientists; Technology; *Universities
IDENTIFIERS	Germany; Japan; United States

ABSTRACT

This report offers a profile of the financial and human resources devoted to research and development (R&D) in the United States and other nations, focusing on the role of universities in carrying out R&D and in supporting the development of scientific and technical personnel needed for a competitive economy. It found that R&D expenditures in the United States in 1992 were an estimated $157.4 billion, making it the leading nation in total R&D expenditures. As a percentage of the nation's economy, however, U.S. R&D expenditures lag behind those of Japan and Germany. R&D expenditures represented 2.65 percent of U.S. gross domestic product (GDP) in 1990, compared with 3.07 percent for Japan and 2.81 percent for Germany. Only 16 percent of all R&D spending is for basic research, while 23 percent is for applied research and 61 percent is for developmental activities to produce useful products from the research findings. Although academic institutions conducted only 15 percent of all R&D activity in the United States in 1992, they conducted 49 percent of all basic research. (MDM)

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ED 382 085

RESEARCH BRIEFS Volume 4, Number 7 • 1993

Division of Policy Analysis and Research
American Council on Education, Washington, D.C.

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Division of Policy Analysis and Research
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Developing Our Future: American R&D in International Perspective

Elaine El-Khawas and Charles J. Andersen

Expenditures for scientific research and development (R&D) have long been seen as a vital component of a nation's economic strength and international standing. Such expenditures offer an indicator of a country's commitment to scientific and technological development and its readiness to invest in innovation and improvement. Increasingly, R&D is recognized as a direct and potent stimulus to a country's overall rate of growth and its standard of living.

The growing importance of international competitiveness has focused new attention on the performance of the U.S. in research and development. There is a new concern about the relative position of U.S. R&D compared to other industrialized countries and heightened awareness of the factors that affect changes in a country's standing. This research brief offers a profile of the financial and human resources devoted to research and development in the United States and in several other countries. Special attention is given to the role of universities in carrying out research and development and, also, in supporting the development of the scientific and technical personnel needed for a competitive economy.

HIGHLIGHTS

INTERNATIONAL COMPARISONS: R&D EXPENDITURES:

- In 1992, U.S. R&D expenditures were an estimated $157.4 billion. The U.S. is the leading nation in R&D spending, with more resources devoted to R&D than the next four nations combined.
- U.S. R&D expenditures represented 2.65 percent of the nation's gross domestic product in 1990. By this measure, comparing R&D activity to the size of a nation's economy, the U.S. currently lags behind Japan and Germany, its major global competitors. The U.S. had the highest ranking on this measure in the mid-1960s.
- Only 16 percent of all R&D spending is for basic research. Another 23 percent is for applied research; the rest, 61 percent of the total, is for development activities to produce useful products from research findings.

INTERNATIONAL COMPARISONS: HUMAN RESOURCES IN R&D:

- In the U.S., an estimated 949,300 scientists and engineers were engaged in R&D activity in 1989. This amounts to about 76 R&D scientists and engineers per 10,000 persons in the labor force.
- Japan is on a par with the U.S. on this measure of scientific capacity, with an estimated 74 R&D scientists and engineers per 10,000 workers.
- The comparable figures for Germany, France and the United Kingdom are much lower, at 59, 50, and 36, respectively.

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THE ROLE OF UNIVERSITIES IN R&D:

- Academic institutions conduct only 15 percent of all R&D activity. Academe's share of R&D is similar in other leading OECD countries. In all countries compared, industry conducts the largest share of R&D.
- Academic institutions are major contributors to basic research. Universities accounted for 49 percent of all basic research in 1992. When university-administered federal research centers (FFRDCs) are included, universities accounted for 59 percent of basic research.
- R&D expenditures by universities have increased steadily in the last decade. Between 1985 and 1992, university R&D grew at an average of 6.3 percent annually.
- Industrial support for university R&D also grew in the last decade. In 1992, industry provided $1.35 billion for university R&D, or 7.1 percent of all university R&D activity.

Major Components of R&D: Some Definitions

Most policy debate and statistical reporting use three categories of research and development activity:

- *Basic Research*: research directed toward increases in fundamental concepts and knowledge.
- *Applied Research*: research directed toward the problems in utilizing concepts and knowledge to address a recognized and specific need or to meet specific commercial objectives.
- *Development*: the systematic use of the knowledge gained from research to produce useful materials, devices, or methods.

Data on R&D normally encompass the sciences (including medical sciences and social sciences) and engineering, but not the humanities.

For universities, R&D data are for separately budgeted expenditures, and exclude research time and expenses not specifically earmarked as R&D. Departmental research supported by general university funds are excluded.

National R&D Expenditures

In 1992, total expenditures in the United States for research and development were an estimated $157.4 billion. This includes $81 billion (51 percent of the total) invested directly by industry as well as $68 billion for R&D provided by the federal government (43 percent of the total). Figure 1 offers a general profile of research and development activity in the U.S. (NSF, 1992).

To highlight academe's role in U.S. research and development activities, two factors need to be understood:

- A very large share of all R&D — 70 percent in 1992, an estimated $110 billion — is performed by industry to support its own needs for product improvement. Academe's share, in contrast, is only 15 percent of all R&D activity. Eleven percent is performed by government agencies, and 3 percent by nonprofit institutions.
- Most R&D — 61 percent in 1992, an estimated $96 billion — is defined as development, with another 23 percent of expenditures ($37 billion) devoted to applied research and only 16 percent ($25 billion) devoted to basic research (see definitions).

Academic institutions therefore contribute a small share of all research and development activity; their contribution is disproportionately in the area of basic research.

- Universities and colleges, together with university-administered research centers (FFRDCs), perform most of the nation's basic research.

FFRDCs

Federally-funded research and development centers are R&D organizations that are exclusively or substantially financed by the federal government on a long-term basis. They are supported by the government to meet a particular R&D objective or to provide major facilities at universities for research and training purposes. Each center is administered by an industrial firm, a university, or other nonprofit institution.

As of 1990, there were 40 FFRDCs, including 18 that are administered by universities. Examples include:

— Ames Laboratory (Iowa State University)

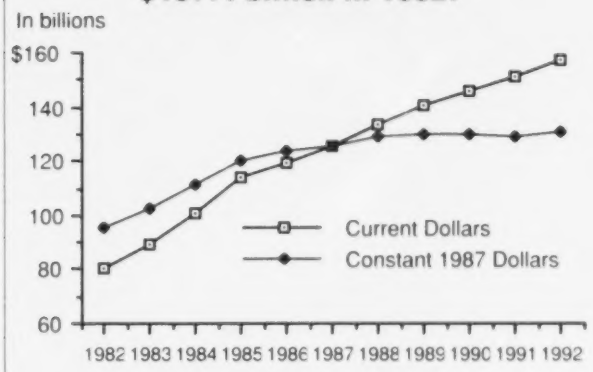
— Lawrence Livermore National Laboratory (University of California)

— Plasma Physics Laboratory (Princeton University)

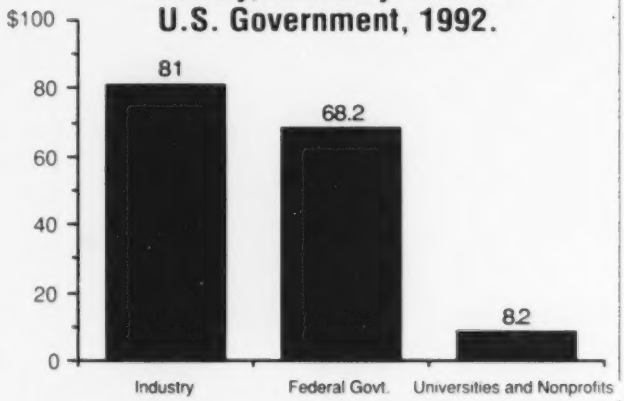
— Software Engineering Institute (Carnegie Mellon University)

Figure 1

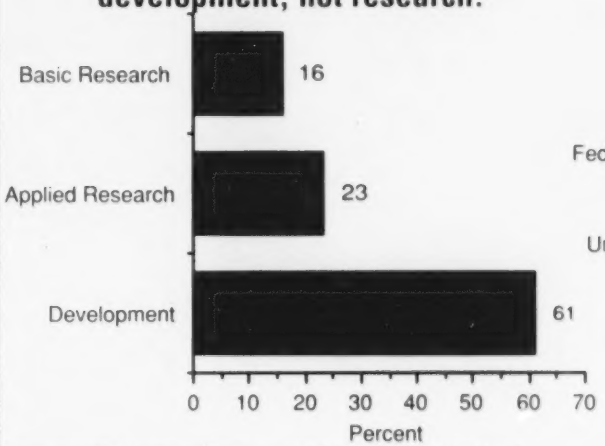
U.S. Expenditures on R&D totalled $157.4 billion in 1992.



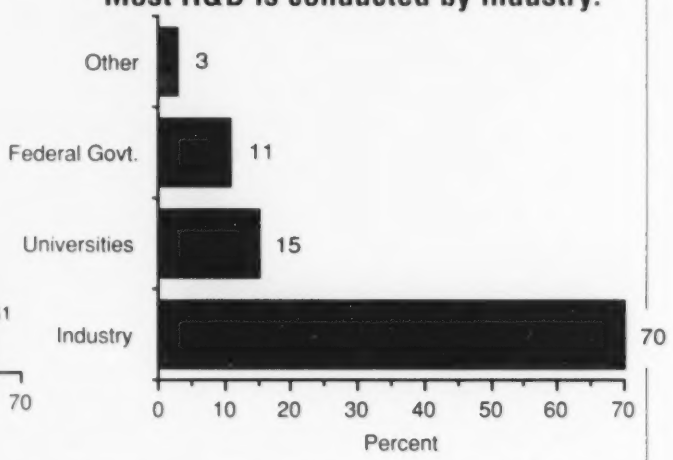
Funds for R&D come mainly from industry, secondly from the U.S. Government, 1992.



Most R&D is directed toward development, not research.



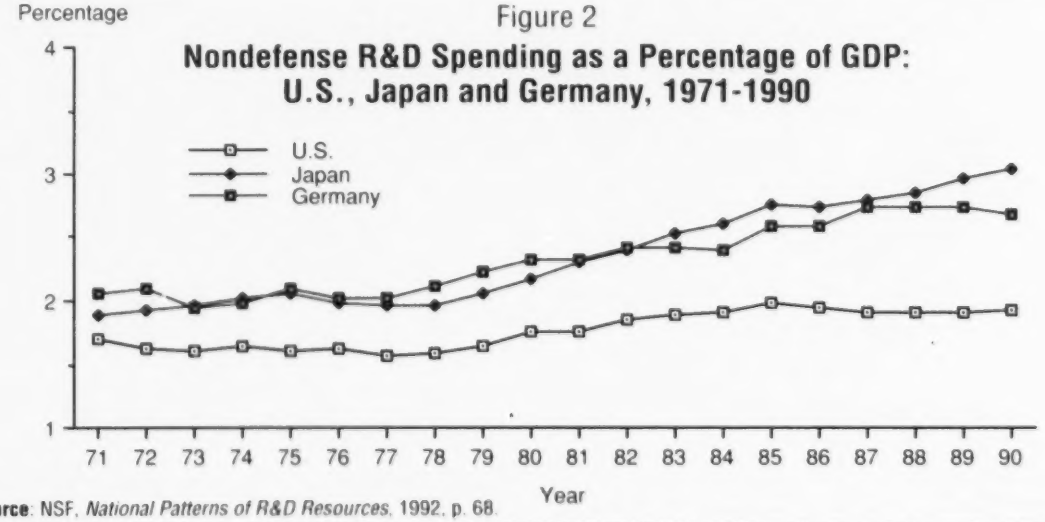
Most R&D is conducted by industry.



Source: NSF, *National Patterns of R&D, 1992*, pp. 18, 48, 49.

Figure 2

Nondefense R&D Spending as a Percentage of GDP: U.S., Japan and Germany, 1971-1990



Source: NSF, *National Patterns of R&D Resources*, 1992, p. 68.

International Comparisons in Expenditure Patterns

In overall spending level, the United States is the leading nation in its investment in research and development. Table 1 shows national expenditures in 1990 for the industrialized countries with sizeable levels of expenditure, expressed in U.S. dollars. In fact, the United States spends more on R&D than the combined total expenditure of the next four nations — Japan, (West) Germany, France, and the United Kingdom.

International comparisons are usually made in terms of the share of each country's gross domestic product (GDP) that is devoted to research and development. GDP, the preferred statistic for such comparisons, measures the value of the goods and services produced in each country, regardless of ownership. International comparisons rely on data compiled by the Organization for Economic Cooperation and Development (OECD) for its 24 member countries. OECD converts each country's currency to purchasing power parities (PPP) expressed in U.S. dollars, a way to adjust for differences in price levels between countries. The reader is cautioned that, to provide comparative data, the latest available figures sometimes are for 1989 or 1990; spending patterns by various nations have changed in some ways since 1990.

Comparisons in this research brief focus on the first five countries shown in Table 1, which comprise the main supporters of R&D activity. Each had at least $20 billion in R&D expenditures in 1990. Data from the National Science Foundation are used because they make some adjustments to OECD-reported data. Inevitably, some inconsistencies remain in definitions and the year for which the most recent data is available. Data on other OECD countries can be found in OECD sources.

In terms of R&D activity as a percentage of a country's total economic activity, the U.S. is not in a leading position (see Table 2).

- In 1990, the United States spent 2.65 percent of its gross domestic product on research and development.
- This puts the U.S. below both Japan and Germany, which spent an estimated 3.07 percent and 2.81 percent of their GDP on research and development in 1990. This represents some erosion from the situation in the early to mid-1960s, when the U.S. spent almost 3 percent of GDP on research and development activities. At that time the United States ranked highest among these countries in R&D spending as a proportion of gross domestic product.
- After 1964, U.S. spending for R&D slowed and the ratio of R&D spending to GDP declined. By 1978, the U.S. ratio of R&D to GDP had reached a low point, 2.1 percent.
- During the same period, the ratios in Germany and Japan increased. In 1978, those nations spent 2.25 percent and 1.98 percent of GDP on R&D.

Table 1

R&D Expenditures of Selected OECD Countries, 1990

U.S.	$149.2 billion
Japan	$ 67.0 billion
Germany	$ 32.3 billion
France	$ 23.8 billion
U.K.	$ 20.2 billion
Italy	$ 12.0 billion
Canada	$ 7.2 billion
Netherlands	$ 4.8 billion
Sweden	$ 3.8 billion
Switzerland	$ 3.8 billion

Source: OECD, *OECD in Figures*, pp. 52-3.

Table 2

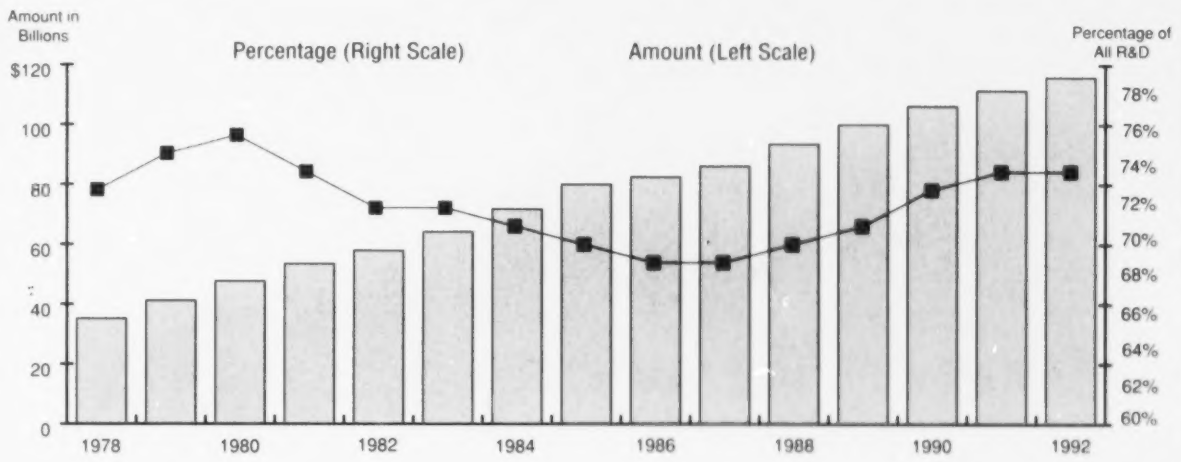
National Expenditures for R&D as a Percentage of GDP, 1982 - 1990

Year	United States	Japan	West Germany	France	United Kingdom
			Total R&D/GDP		
1990	2.65	3.07	2.81	2.40	NA
1989	2.68	2.98	2.88	2.34	2.27
1988	2.73	2.86	2.86	2.28	2.23
1987	2.76	2.82	2.88	2.27	2.25
1986	2.80	2.75	2.73	2.23	2.34
1985	2.82	2.77	2.72	2.25	2.31
1984	2.68	2.63	2.51	2.21	NA
1983	2.62	2.55	2.52	2.11	2.25
1982	2.54	2.41	2.52	2.06	NA
			Nondefense R&D/GDP		
1990	1.93	3.04	2.67	1.83	NA
1989	1.91	2.96	2.74	1.83	1.85
1988	1.91	2.84	2.73	1.77	1.81
1987	1.90	2.80	2.73	1.78	1.77
1986	1.94	2.73	2.59	1.75	1.81
1985	1.98	2.76	2.58	1.78	1.72
1984	1.90	2.61	2.40	1.74	NA
1983	1.89	2.53	2.41	1.66	1.66
1982	1.84	2.40	2.42	1.59	NA

NA: not available
Source: NSF, *National Patterns of R&D Resources: 1992*, Table B-20

Figure 3

Nondefense R&D as a Percentage of All R&D, 1978-92 (In current dollars)



Source: NSF, *National Patterns of R&D Resources, 1992*, Tables B-2, B-21.

- The U.S. recovered much ground by 1990. However, increases also continued in Germany and Japan, so that their ratios in 1990 still are higher than those of the U.S.

When nondefense R&D is considered, the U.S. is well behind its two leading competitors (see Figure 2).

- In 1990, the U.S. spent 1.93 percent of its gross domestic product on nondefense R&D spending. This is considerably lower than the 1990 figures for Japan (3.04 percent) and Germany (2.67 percent).
- In the United Kingdom and France, each of which have substantial R&D activity tied to defense, the ratio of nondefense R&D to Gross Domestic Product — 1.85 percent in the former and 1.83 in the latter — was quite close to the ratio for the U.S.

In 1990, about three-quarters of U.S. research and development was directed to nondefense activities. In contrast, Japan and Germany spent more than 90 percent of their R&D for nondefense purposes.

However, the U.S. trend appears to be changing. From 1987 to 1992, R&D devoted to nondefense activity increased steadily, growing from $86 to $116 billion; nondefense activity has increased from 69 to 74 percent of all U.S. R&D expenditures (see Figure 3). It remains to be seen whether these figures will continue to increase as a result of the easing of international tensions. A major question is whether a larger portion of the billions currently allocated to defense-related R&D ($42 billion in 1992) will be directed toward federal nondefense R&D activities.

In 1990, the university share of defense activity was relatively small. Department of Defense R&D obligations to academe amounted to $1.2 billion, 13 percent of total *federal* R&D obligations to colleges and universities and only 7 percent of all academic R&D that year.

R&D Scientists and Engineers: International Comparisons

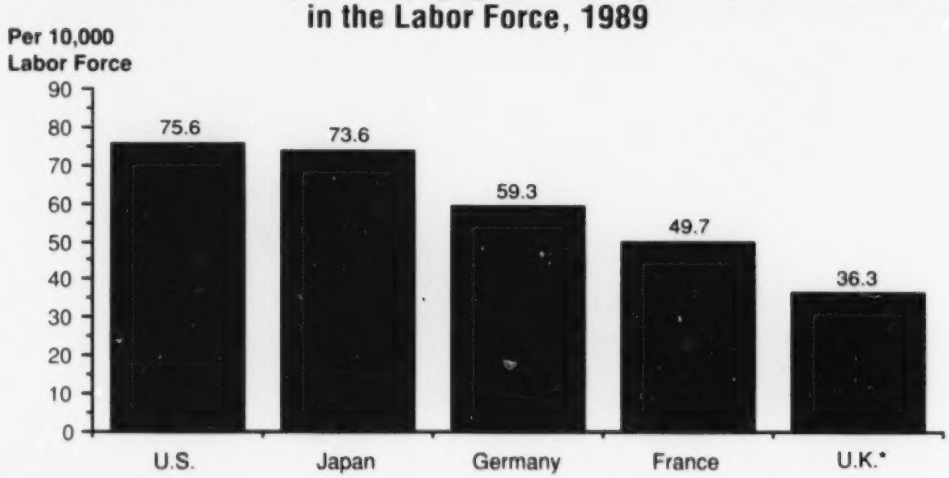
Another measure of a nation's R&D capacity is the number of highly trained persons in each country who are able to contribute to research and development activities. A measure that is used in international comparisons is the proportion of a country's total labor force that is engaged in R&D activity. Differences in how human resources data are collected in various countries put limits on these comparisons, however.

In the U.S., an estimated full-time equivalent of 949,300 scientists and engineers[1] were engaged in R&D activity during 1989. Most of these persons — 77 percent — were employed in industry. Academic institutions employed 18 percent of the total number of R&D scientists and

[1] *These are persons in professional positions engaged in R&D, but not all hold doctorates.*

Figure 4

Scientists and Engineers Engaged in R&D per 10,000 Persons in the Labor Force, 1989



Note: Data for the U.K. are for 1988.
Source: NSF, *National Patterns of R&D Resources: 1992*, p. 69.

engineers. Six percent worked at federal government agencies.

The number of U.S. scientists and engineers actively engaged in R&D has increased substantially in the last two decades. The total grew from 543,800 in 1970 to 949,300 in 1989, a 75 percent increase. This total number of R&D personnel far exceeds the number so employed in other leading OECD countries.

- In Japan, a total of 461,600 professionals were engaged in R&D in 1989. This figure is for total persons, not full-time-equivalents.
- The comparable totals for (West) Germany and France in 1989 are much lower, at 176,400 and 120,700. A 1988 estimate for the United Kingdom is 102,600, although these persons are only from government and industry.

The U.S. R&D cadre is also substantial when measured as a proportion of the total labor force. In 1989, about 76 R&D scientists and engineers were engaged in R&D in the U.S. per 10,000 persons in the labor force. This figure has increased steadily since the mid-1970s, when it was at a low of about 55 R&D professionals per 10,000 in the labor force.

International comparisons are striking (see Figure 4). Notably, Japan has a similar rate: 74 R&D scientists and engineers per 10,000 persons in the labor force in 1989.[2] This reflects rapid growth in the R&D cadre over the last 20 years in Japan.

- Back in 1970, Japan had 33 R&D scientists and engineers engaged in R&D per 10,000 persons in the labor force. (The U.S. figure in 1970 was 64, then dropped to the low point noted above.)
- By 1980, the figure for Japan had grown to 54 per 10,000. (The U.S. figure in 1980 was 60, a slight decline from 1970.)

Other countries also have had substantial growth in the number of R&D scientists and engineers over the last 20 years.

- In 1989 (West) Germany had 59 R&D scientists and engineers per 10,000 in the labor force. This represents almost a doubling since 1970, when the figure was 31.
- In 1989, France had 50 R&D scientists and engineers per 10,000 in the labor force, up substantially from 27 in 1970.
- The United Kingdom had 36 R&D scientists and engineers per 10,000 persons in the labor force in 1988, a small increase over a 1972 estimate of 30. These data are an understatement compared to other countries, as they do not include scientists and engineers in universities.

These figures will see dramatic supplementation in the coming decade as data from Asian countries become available. In 1990 six Asian countries (China, India, Japan, Singapore, South Korea and Taiwan) reported the award of three times as many bachelor's degrees in the natural sciences and engineering as the United States (514,200 vs. 169,700). Although the U.S. awarded more doctorates in these disciplines than the Asian countries — 16,300 vs. 9,700 — about 3,200 or 20 percent of the U.S. doctorates in these disciplines went to students from these countries.

[2] *The data for the U.S. and Japan are not strictly comparable: the U.S. data are adjusted to be full-time equivalent, except for federal government personnel, and include social scientists in government and in universities. The data for Japan represent scientists and engineers working in R&D without a full-time-equivalent adjustment, excluding social scientists.*

The Role of Universities in R&D

In 1992, universities in the U.S. accounted for an estimated $19 billion in R&D activity (see Figure 5); university-administered FFRDCs accounted for another $5.1 billion. Together, this constituted about 15 percent of U.S. R&D in 1992.

Academic R&D activity is relatively concentrated: 40 universities accounted for half of all academic R&D expenditures in the U.S. in 1990. Over the last decade, some dispersion of funding across a wider number of universities has taken place; in 1980, half of academic R&D was conducted by 35 universities (Feller and Geiger, 1993). However, from an overall perspective, academic R&D activity is still quite concentrated. Of 2,100 baccalaureate-granting institutions in the U.S., only 104 carry the Carnegie classification of "research university." These 104 institutions devoted approximately 16 percent of their expenditures to research in contrast to the 5 percent reported for all other baccalaureate-granting institutions. In 1991, 70 research universities received 70 percent of the $10 billion provided by the federal government to all institutions for science and engineering R&D (NSF, 1993).

Total R&D activity by universities (excluding FFRDCs) has steadily increased in the last decade (see Figure 5). Between 1980 and 1985, inflation-adjusted growth was 3.6 percent annually; between 1985 and 1992, university R&D grew even more rapidly, at an average of 6.3 percent annually after inflation.

Collaborative R&D activity between industry and universities has been growing (see Figure 6).

- In 1992, industry provided $1.35 billion for R&D spending at universities, or 7.1 percent of all R&D expenditures by universities.
- Back in 1980, by comparison, industry supported only 3.9 percent of R&D expenditures at universities.

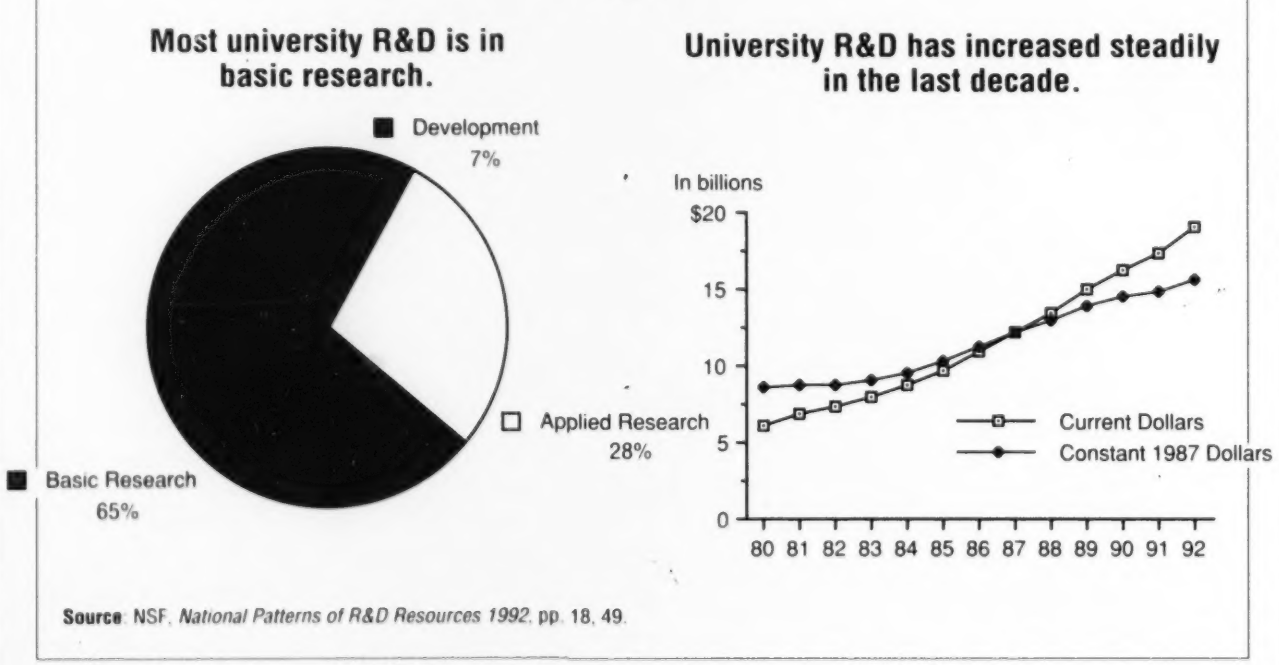
In 1991, for example, the Massachusetts Institute of Technology received $45.7 million from industry to support R&D, more than any other university. MIT was followed by Pennsylvania State University and the universities of Michigan, Washington (Seattle), and Illinois at Urbana.

University-industry cooperation takes many forms, including industry-sponsored contract research focused on specific outcomes, major multi-year university-industry research agreements, personnel exchange programs, research consortia, and cooperative research centers (BHEF, 1988).

Another change during this period was a gradual increase in investment in R&D from universities' own funds or from state/local government.

- In 1992, universities spent $5.3 billion of their own funds or of state/local government funds for R&D activity. This constituted 28 percent of academic R&D expenditures.
- Back in 1983, institutional or state funds provided somewhat less, 24 percent, of academic R&D.

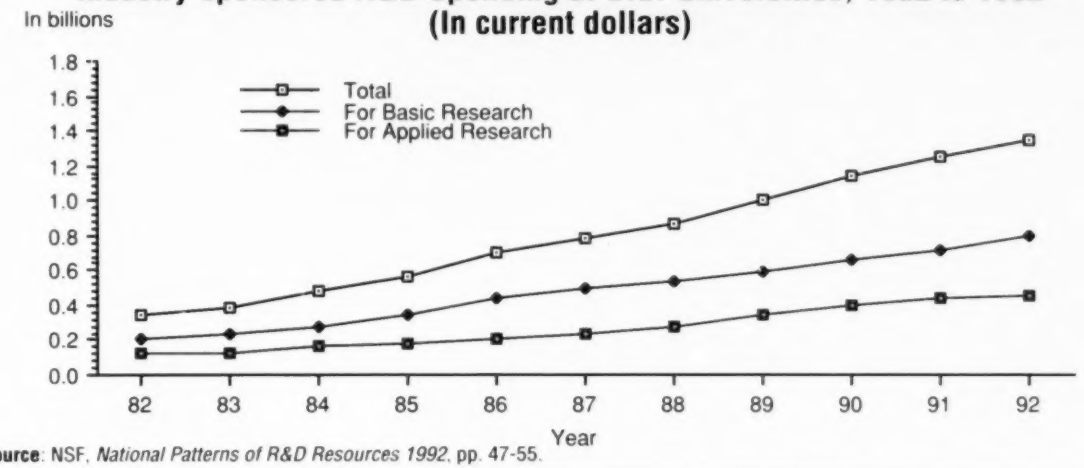
Figure 5



Source: NSF, *National Patterns of R&D Resources 1992*, pp. 18, 49.

Figure 6

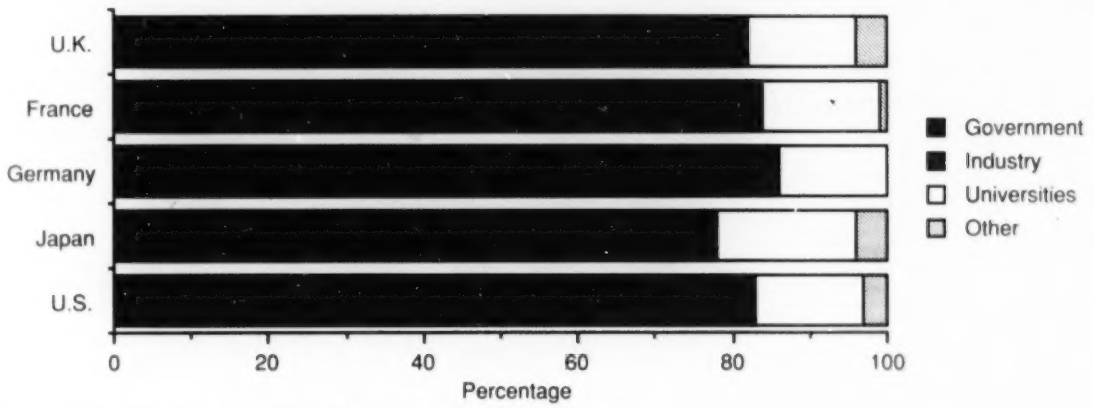
Industry-sponsored R&D Spending at U.S. Universities, 1982 to 1992 (In current dollars)



Source: NSF, *National Patterns of R&D Resources 1992*, pp. 47-55.

Figure 7

Where R&D Activity Is Located, 1989



Source: NSF, *Science and Engineering Indicators: 1991*, Appendix Table. 4-28.

The Role of Universities: International Comparisons

Several international comparisons help give perspective on the R&D role of U.S. universities.

- In 1989, higher education (including FFRDCs) in the United States accounted for 14 percent of all U.S. R&D expenditures.
- Other leading OECD countries report a very similar university share (see Figure 7).
- The share of R&D performed by universities is highest in Japan, at 18 percent.
- The range among countries for university-based R&D was much wider in 1975, from a low of 8 percent in the U.K. and 13 percent in the U.S. to the much higher rates of 20 percent in Germany and 28 percent in Japan.

Substantial country differences exist in the way R&D activity is distributed across sectors (see Figure 7).

- Industry is the primary focus of R&D activity in each country, but the industry proportion in 1989 ranged from 72 percent in the U.S. and Germany down to 60 percent in France.
- Governmental bodies carry out a moderate proportion of R&D, although the country-to-country range is quite wide. France has the highest figure, with 24 percent of R&D conducted by governmental research units. Japan had only 8 percent of R&D conducted by government in 1989, close to the U.S. figure of 11 percent.

Spending on Basic Research: International Comparisons

In the United States, basic research received $25 billion, or 16 percent, of all R&D funding in 1992. This represents a slight increase since 1980, when basic research was 13 percent of R&D expenditures (NSB, 1991).

- Universities were responsible for almost half (49 percent) of all basic research expenditures in the U.S. in 1992. This amounted to $12 billion in expenditures.
- Including FFRDCs, the total university share is 59 percent, nearly $15 billion.

Most basic research carried out by U.S. universities is funded by the federal government.

- Federal agencies provided the funds for 61 percent of basic research expenditures at universities in 1992 ($7.4 billion).
- Non-federal sources, including industry and state governments, provided 39 percent ($4.8 billion) of total spending on the basic research conducted by universities in 1992.

Basic research plays a somewhat larger role in R&D in other countries.

- In France, 23 percent of total R&D in 1988 was devoted to basic research.
- In Germany, in 1987, basic research accounted for 19 percent of total R&D spending.
- In Japan, the share of R&D devoted to basic research, at 13 percent in 1988, is quite similar to that for the U.S.

These comparisons must be interpreted cautiously because some use of general university funds is included in the non-U.S. figures.

CONCLUSION AND IMPLICATIONS

Universities in the United States play an important role in the national economy through their contribution to the nation's total effort in research and development. Universities, together with university-administered research centers (FFRDCs), perform most of the nation's basic research. In the past decade, universities also have increased their linkages with industry on R&D activity.

Major national policy decisions will affect the university role in R&D in the future. The current administration supports increased investment in science and technology, but disagreements exist on which fields and which problems deserve priority. As the U.S. directs greater effort toward nondefense R&D, universities will need to help address the challenges of defense conversion, including paying attention to dual-use technologies and to the retraining needs of scientific and engineering personnel. If the nation supports a push toward a more highly skilled and technically competent labor force, the education and training role of many universities, colleges, and community colleges could be expanded.

As the international comparisons indicate, other OECD nations are close to or on a par with the U.S. on several measures of R&D commitment and capacity. Although R&D performance alone does not guarantee economic success, most governments recognize its vital contribution. Many of these governments have announced or implemented policies designed to strengthen their own R&D activity. Their actions, and results, undoubtedly will influence U.S. policy decisions.

But the exact relation between R&D and economic growth and competitiveness is unclear. This is particularly true of basic research conducted in academic settings. Some may argue that this country's dominance of the world aircraft industry was made possible largely by R&D activity carried on for defense purposes and successfully transferred to the civilian market. Others note that U.S. development of transistors and computer chips has not resulted in U.S. dominance of the global consumer electronics industry.

Whereas challenges to the appropriateness of linkages between universities and companies still exist, productive cooperative programs have been developed that can serve as models and provide examples of ways to overcome potential barriers to cooperation between business and institutions of higher education.

Comparative measures of international performance need to be monitored and clarified to describe more fully the changing roles universities play in R&D and, more broadly, the status of the U.S. relative to other countries. Data are needed, for example, that compare regional groupings, including the European Economic Community and the rapidly developing nations in Asia.

Universities offer the expertise, resources, and appropriate environment for conducting research and development activity that can help the U.S. remain competitive with other countries. The continued linkages between universities and federal government agencies and, increasingly, between universities and industry, should serve the nation's R&D needs well in the future.

RESOURCES

1. The National Science Board (NSB) is the governing board of the National Science Foundation (NSF) and, under its own imprimatur, publishes *Science and Engineering Indicators*, a report that is prepared by the NSF staff. *Indicators* contains extensive tables describing U.S. research and development activity and resources, plus limited comparable data for other major industrial countries. This report appears every other year. The next edition will be published in 1994 and will be available from NSF (see below).
2. The National Science Foundation (NSF), an agency of the U.S. government, conducts various survey and

publication activities, including extensive annual reports on research and development (R&D) resources in the U.S. These publications include: *Federal Support to Universities, Colleges and Nonprofit Institutions*, issued annually, *Federal Funds for Research and Development*, issued annually, and *Academic Science and Engineering: R&D Expenditures*, issued annually.

NSF also publishes data on specific issues or concerns regarding R&D in its Data Briefs series, which replaced *Science Resources Studies Highlights*. *Data Briefs* are available in printed form and on NSF's electronic bulletin board (see below).

NSF makes many of these data available electronically through its Science and Technology Information System (STIS). For information on STIS, call (202) 357-7555; for information on printed publications, diskettes, and tapes, contact the Division of Science Resources Studies, Room L 609, National Science Foundation, Washington, DC 20550; telephone: (703) 306-1772.

3. The Government-University-Industry Research Roundtable is a nonfederal forum sponsored by the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. It permits scientists, engineers, administrators, and policymakers from government, academia and industry to meet on an ongoing basis to explore ways to improve the productivity of the nation's research enterprise.

   In 1989, the Roundtable published a discussion paper, *Science and Technology in the Academic Enterprise: Status, Trends, and Issues*, which examined current trends in the university research enterprise and described the extent of research and development in this country in the 1980s and before. In 1992, it published another discussion paper, *Fateful Choices*, that noted the importance of international research cooperation in the next century.

   The Roundtable is housed at the National Academy of Sciences, 2101 Constitution Avenue, NW, Washington, DC 20418; telephone: (202) 334-3486.

4. The Council on Competitiveness, founded in 1986, is a nonprofit organization of chief executives from business, higher education, and organized labor working to improve the international competitiveness of American companies and workers. It focuses on competitiveness issues in the areas of science and technology, investment, international economics and trade, and human resources. It sponsors conferences and special reports, and issues a monthly newsletter, *Challenges*.

   For information, contact the Council on Competitiveness, 900 17th Street, N.W., Suite 1050, Washington, D.C. 20006; telephone: (202) 785-3990.

5. The Organization for Economic Co-operation and Development (OECD) is composed of 24 member countries with highly industrialized economies. It gathers data from its members and makes it available through printed and electronic means.

   An OECD series, Main *Science and Technology Indicators* , is published twice yearly. It contains data on research and development expenditures by member countries by source and performer, in addition to limited information about research and development personnel. Data from this report also are available on IBM formatted diskettes for micro-computers.

   An annual publication, *Basic Science and Technology Statistics*, provides additional statistics concerning each member country's economy and science and technology activities. Those data also are available on IBM formatted diskettes.

   OECD also publishes STI — *Science, Technology and Industry Review*. It appears twice yearly and addresses the latest topics "on technology, production structures, the role of government, industry and economic growth."

   OECD, headquartered in Paris, France, maintains a Publications and Information Center at Suite 700, 2001 L Street, NW, Washington, DC 20036-4910; telephone: (202) 785-6323.

6. The National Center for Education Statistics (NCES) is a part of the U.S. Department of Education and publishes an annual *Digest of Education Statistics*. This publication shows research expenditures and basic gross national product/gross domestic product data (GNP/GDP) for the U.S. In addition, it provides some limited population and "third level" enrollment, completion, and expenditure data for countries other than the U.S.

   For information, contact the NCES Information Office, (202) 219-1659. Publication orders should be directed to Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402-9328; telephone: (202) 783-3238.

7. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) publishes a *Statistical Yearbook*. Expenditure and personnel data for research and development are shown for each country, albeit with inconsistencies in definitions and variable coverage. UNESCO is headquartered at 7, place de Fontenoy, 75700 Paris, France., and has a Liaison Office at 2 United Nations Plaza, Room DC2-0934, New York, NY 10017; telephone: (212) 963-5978.

8. The World Bank has an active publications program concentrating on issues related to developing countries. It publishes *Research Observer* twice yearly — in January and July. This journal contains articles dealing primarily with economic issues. From 1986 to 1992, only one article addressed education specifically. The World Bank also publishes an annual *World Development Report* that each year focuses on a major issue such as poverty or ecology. *Report* also provides selected social and economic statistics (population, GNP, government expenditures, enrollment) for over 100 countries. For further information, contact World Bank Publications, 701 18th Street, NW, Washington, DC 20433; telephone: (202) 473-2941.

9. The Business Higher Education Forum (BHEF) is an organization of selected chief executives of major American corporations and colleges and universities.

Founded in 1978 by the American Council on Education, the Forum identifies, reviews, and acts on selected issues of mutual concern to corporations and institutions of higher education. It publishes the results of studies undertaken regarding such issues.

For information, contact the Forum, Suite 800, 1 Dupont Circle, N.W. Washington, D.C. 20036; telephone (202) 939-9345.

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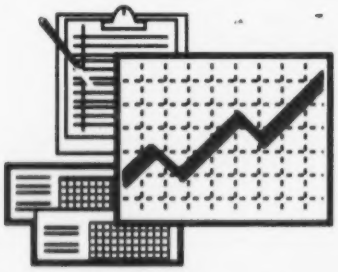

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